Appendix A—Climate Change Benefits of Biomass CHP

CHP systems offer considerable environmental benefits when compared with purchased electricity and onsite-generated heat. By capturing and utilizing heat that would otherwise be wasted from the production of electricity, CHP systems require less fuel than equivalent separate heat and power systems to produce the same amount of energy. Because less fuel is combusted, greenhouse gas emissions, such as CO_2, as well as criteria air pollutants like NO_x and SO_2, are reduced. The use of biomass fuels in CHP, rather than natural gas or coal, further reduces CO_2 emissions from heat and power production. In addition to displacing the emissions of purchased fossil fuels that would otherwise be needed to separately generate thermal energy (rather than using captured waste heat), biogenic biomass[77] is typically considered a net zero emitter of CO_2 when used as a fuel for electricity and heat generation.[78]

National and international protocols for calculating and reporting GHG emissions generally require consideration of the three GHGs that are released when biomass is combusted for electricity (and heat) production: CO_2, methane, and nitrous oxide (N_2O). Scientific consensus states that the CO_2 emitted from burning biomass will not increase total atmospheric CO_2 if this consumption is done on a sustainable basis.[79] Because CO_2 is captured from the atmosphere by plants and trees during their growth, when it is released again during combustion it is reentering the carbon cycle, not being newly created. If plant materials are then regrown over a given period of time, the regrowth of new biomass takes up as much CO_2 as was released from the original biomass through combustion.[80] This process results in a cycle in which biomass fuels are considered to emit a total of zero net CO_2 emissions and are classified as green power when used to generate electricity.

Methane and N_2O are also created when biomass is combusted; however, unlike CO_2, they are not considered part of the natural degradation/recycling process and therefore are treated as direct emissions. Emissions of these gases from stationary combustion sources depend upon fuel characteristics, size and vintage of the combustion equipment, along with combustion technology, pollution control equipment, and ambient environmental conditions.[81] Emissions also vary with operation and maintenance practices. Therefore, most protocols (i.e., Intergovernmental Panel on Climate Change [IPCC] Guidelines, California Climate Action Registry [CCAR], EPA's National Inventory, and United Nations Framework Convention on Climate Change [UNFCCC] Clean Development Mechanism [CDM] Guidance)[82] require documentation of methane emissions from biogenic biomass combustion, though these emissions are generally small compared to CO_2 emissions. Though a potent GHG, N_2O as a byproduct of combustion is typically created in such small quantities that most protocols do not require estimation or reporting of N_2O emissions, although two do—the IPCC Guidelines (national-scale inventory) and CCAR (company-level inventory).[83]

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[77] Biogenic biomass refers to all organic biomass, such as wood, agricultural crops, landfill gas, and digester gas. Anthropogenic biomass consists of human-made materials that can be combusted for electricity and heat production, such as waste tires or portions of MSW, and is not included in the discussion of biomass fuels within this appendix. Note that the GHG emissions from the biogenic portion (e.g., yard waste, food scraps) of MSW is typically netted out of the total emissions and treated as biogenic biomass (e.g., CCAR, 2005).

[78] CCAR, 2007; Center for Resource Solutions, 2007; IPCC, 2006; EPA, 2004c; EPA, 2007b; UNFCCC, 2007a; UNFCCC, 2007b; UNFCCC, 2006a; UNFCCC, 2006b; WRI/WBCSD, 2007.

[79] UNFCCC, n.d.

[80] EPA, 2007b.

[81] EPA, 2007b.

[82] CCAR, 2007; IPCC, 2006; EPA, 2007b; UNFCCC, 2007a; UNFCCC, 2007b. Note that the UNFCCC does not require reporting of methane emissions for biogas projects because the emission source is assumed to be very small (UNFCCC, 2006a).

[83] CCAR, 2007; IPCC, 2006; EPA, 2004c; EPA, 2007b; UNFCCC, 2006a; UNFCCC, 2006b; UNFCCC, 2007a; UNFCCC, 2007b.

Additional Issues

Some project-specific evaluations of GHG emissions calculate emissions based on the life cycle of the fuel, in addition to the combustion process used to transform its energy into electricity and/or heat (e.g., UNFCCC CDM).[84] These life-cycle analyses often consider the energy required to plant, grow, fertilize, harvest, transport, and convert the fuel to a usable feedstock before it is combusted. Currently, this type of calculation is not generally used in most of the major international or national protocols and guidance, but may be included in some project-level analyses depending on how project boundaries are drawn.

Offset project protocols typically require calculating emission reductions based on a comparison to the counterfactual—what the emissions would have been in the absence of the project. For example, for a biogas-fueled CHP project, the GHG emission reductions from offsetting purchased grid electricity and a natural gas-fueled boiler are calculated relative to the efficiency of the CHP system and the state of the digester fuel (biogas) before the project started. If the digester were in place prior to the CHP system's addition and the gas had been flared, the GHG emission reductions from the biogas fuel will be calculated relative to those released when flaring the digester gas. If the digester and the CHP system were installed at the same time, the GHG emission reductions of the biogas will be calculated relative to the emissions from uncontrolled manure decomposition. Emission reductions from certified offset projects are typically calculated through a detailed and laborious process and might include life-cycle analysis of emissions.[85]

[84] UNFCCC, 2006a; UNFCCC, 2006b; UNFCCC, 2007a; UNFCCC, 2007b.
[85] DOE, n.d.; RGGI, 2007; UNFCCC, 2006a; UNFCCC, 2006b; UNFCCC, 2007a; UNFCCC, 2007b.